USING EDGES AND CORNERS FOR CHARACTER INPUT

[0001] This application claims priority from U.S. application serial No. 60/460,296 entitled Using Edges and Comers for Character Input, filed Apr. 4, 2003, the entirety of which is hereby incorporated by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

[0002] This work was supported by NSF contract no. UA-0308065. The federal government may have certain rights in this invention.

BACKGROUND

[0003] This invention relates to methods and systems for entering characters into a handheld or wearable computerized device, such as a handheld computer also called a "personal digital assistant," a cell phone, a watch, a computer game console, or the like.

[0004] Text input is difficult on handheld and wearable computerized devices. Handheld devices include cell phones, two-way pagers, game console controllers, and "Personal Digital Assistants" (PDAs), including those made by Palm, Inc. and the devices which run Microsoft's WindowsCE operating system. In the future, we expect that wearable devices such as wristwatches and other small computerized devices will need good text entry methods. Today, PDAs and two-way pagers primarily use on-screen "soft" keyboards, handwriting recognition, tiny physical keyboards used with the thumbs, or special gestural alphabets such as Graffiti from Palm, Inc. or Jot from Communication Intelligence Corporation (CIC). Cell phones primarily use multiple taps on the standard 12-key number pad, possibly combined with a prediction technique such as T9. Game controllers primarily use a joystick to iterate through characters, or else to select letters from a keyboard displayed on the television screen.

[0005] On-screen "soft" keyboards are small and the keys can be difficult to acquire. They also consume precious screen space. To address these problems, some researchers have attempted to discover the "optimal" soft keyboard. Zhai, S., Hunter, M., Smith, B. A. "Performance optimization of virtual keyboards", Human-Computer Interaction 17, Lawrence Erlbaum, 2002. pp.229-269. Many soft keyboard designs exist, and an overview is provided in MacKenzie, I. S., Soukoreff, R. W. "Text entry for mobile computing: Models and methods, theory and practice", Human-Computer Interaction 17, Lawrence Erlbaum, 2002, pp. 147-198. On-screen "soft" keyboards also require the user to focus attention on the keyboard rather than on the output, resulting in errors related to increased focus-of-attention. This is particularly a problem when the user does not want to look at the handheld device, such as when walking, driving, or producing output that appears on a separate display, such as on a television or desktop monitor. MacKenzie, I. S., Zhang, S., "The immediate usability of Graffiti", Proc. Graphics Interface '97. Canadian Information Processing Society, 1997. pp.129-137. Gestural text entry techniques, such as Graffiti and Jot, also do not completely solve the problem of text input. They can be difficult to learn and error-prone. Early gestural text entry techniques have a history dating back to as early as 1957. Diamond, T. L. "Devices fro reading handwritten characters", Eastern Computer Conference, 1957, pp 232-237. Unistroke methods, for example, separate characters during text entry by pen-down/pen-up sequences. The term "unistroke" originated from the alphabet by the same name-Unistrokes-developed at Xerox PARC [Goldberg, D., Richardson, C., "Touch typing with a stylus", proc. INTERCHI '93, pp 80-87] and U.S. Pat. No. 5,596, 656, January, 1997, Goldberg. But Unistrokes did not resemble real letters, and for this reason, they were difficult to learn and memorize. Graffiti from Palm, Inc. carried the unistroke concept to the masses by making the character forms similar to handwritten forms that proved much easier to learn and memorize. A later unistroke research effort discovered that the easiest gestures to make on a variety of devices were in the four cardinal directions, so a "device independent" alphabet called MDITIM was created using them. Isokoski, P., "A minimal device-independent text input method", unpublished thesis, University of Tempere, Finland, 1999.

[0006] In contrast to unistrokes, continuous gesture techniques do not require lifting the stylus between characters, which can improve the speed of input. Rather than making character forms, the user moves the stylus through different regions, and segmentation between letters is accomplished by exiting one region and entering another. An example is Quikwriting [Perlin, K. Quikwriting, "Continuous stylus-based text entry", Proc. UIST '98. ACM Press, 1998. pp.215-216.], described in U.S. Pat. No. 6,031,525, February, 2000, Perlin. These methods generally have the same increased focus of attention problems as soft keyboards because they require constant visual attention.

[0007] Entering text using the standard 12-key number pad or using tiny keyboards is slow and unnatural, and techniques such as T9 help only a little.

[0008] All of these techniques are especially difficult to use in a number of circumstances, such as when the user is walking, riding a frequently-stopping bus, or not looking at the screen ("eyes free" entry). Even expert users of these techniques will make many errors that they must correct using the backspace key or backspace stroke.

[0009] People with motor impairments have a particularly difficult time entering text using these existing technologies. People with Cerebral Palsy, Muscular Dystrophy, and Parkinson's Disease, for example, often lose their gross motor control and arm strength before losing their fine motor control and may therefore still be able to use a stylus or joystick. But they often do not have sufficient accuracy of movement to hit the tiny keys of an on-screen keyboard. The gestural text entry techniques may be impossible for people with motor impairments due to tremor and fatigue, which dramatically affect a user's ability to make smooth, accurate, and controlled movements. Another result of tremor is that many users "bounce" the stylus on the screen, triggering unwanted modes and unwanted characters in today's gestural systems. A more stable means of text entry is necessary for users of handheld devices who have motor impairments.

[0010] Able-bodied users would also benefit from more stable means of text entry. Since PDAs are designed to be used "on the go," many situations arise where added stability would be beneficial: riding a bus, walking, or annotating slides during a presentation while standing.

[0011] Another disadvantage for all users of the gestural and on-screen keyboard techniques is that they require a